STUDIES ON THE BENTHIC COMMUNITIES OF RIVERINE AND ESTUARINE ZONE OF PURNA RIVER, NAVSARI, GUJARAT

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Introduction :-

All water resources such as tanks, ponds, rivers, streams, estuaries and oceans serve as habitat for various aquatic fauna and flora. **(Verma *et al*; 2003)**

Among these all resources most freshwater stream flows to the ocean level and meet the sea, under special conditions, the flow of freshwater to the ocean is partially enclosed and outlet to the sea restricted to a relatively narrow opening. These places are referred to as "Estuaries". Within the estuary, freshwater from the lands flows upon and meets the denser salt water of the ocean. **(Yadav *et al*, 2004)**

As the water of the two generally do not mix quickly but remain temporarily as separate layers. The estuary may extend up to the river channel for a considerable distance and out into an ocean. Because of these resistances to sudden mixing, the nature of the environment and the two water bodies tends to be a great variation in the estuary and at the same locations at different time. **(Palmer; 1980)**

The rivers are not only long distance movers of water but also serve as conducts for dissolved and suspended material which can be organic/inorganic and living/nonliving**(Yadav *et al*, 2004).** The flowing water carrying these materials and transported over long distances and discharge to bigger water - river, estuary and to the sea **(Gupta *et al*; 2003)**

The suspended materials brought down in rivers tend to remain in suspension because the river channel is relatively narrow. As the river widens out into the estuary, the water energy is dissipated over a wider area, and the sediment begins to settle out depending on their origin and textural properties in different areas of the estuary **(Wilson; 1988).** So the estuary become shallower and this factor stimulate the rapid cycling of nutrients between organic and inorganic phases **(Palmer; 1980).** This characteristic of estuaries makes them the most productive habitats on earth. But these sites are also physically demanding and only a few species can tolerate the rigors of successive exposure to fresh and sea water, and the wide fluctuation in temperature associated with these environments. Estuary may also serve as a breeding ground and

nursery for many marine fish species. They store nutrients for larval and juvenile marine life. As various species mature, they leave the estuary and head out to sea. Thus there is a constant movement of the rich organic and nutrient material to the sea. As tide moves in and out there is also a movement of the materials out to the sea. And thus it is that the stream flows to the sea and enriches the shallow coastal water of the marine environment. **(Yadav *et al*, 2004)**

Purna is a perennial river of Navsari district in South Gujarat. It originates in Amravati district of Maharashtra and flows through Akola, Buldhana and Jalgaon district. Most of the drainage flows from north to south. The Purna river flows from East to the West and joins Tapi river. Purna bounded by a fault along the Satpuras of Southern Madhypradesh state and flows westward; draining Maharashtra's Vidarbha region before emptying into the Tapi River at Changdev in Jalgaon district of Maharashtra. In Gujarat the narrow Purna river broadens into a wide estuary (lt. 21'55' N & ln. 72'45' E) with the width exceeding 1500m in the mouth region during spring tides. The width is about 500m at 20km inland. The estuary is shallow with channel depth <2m during low tides when extensive sandbanks in the mouth region get exposed. (http://www.casmbenvis.nio. in/files/04.publication.estuaries%zastatus.pdf)

The rivers experience a pronounced freshwater discharge during monsoon period that is July and August. Flow diminishes considerably during the post-monsoon and is minimum during May and June. Seawater intrusion and the tidal influence in the estuary are affected by river flow.

The estuary experiences semidiurnal tides with 2 high tide and 2 low tides with varying water amplitudes.

(http://74.125.153.132/search?q=cache:_v6fg_aw5lgJ:www.nio.org/past_events/mandovi_zuari/P_nar.pdf+PURNA+ESTUARY&cd=2&hl=en&ct=clnk&gl=in)

The sediments which are the collection of fine medium and the coarse grain minerals and organic particles that are found at the bottom of the estuaries are also a essential component as they provide habitat for a wide varieties of benthic organisms as well as juvenile forms of pelagic organisms **(Wilson; 1988).**

Benthic organisms are those that live on or inside the deposit at the bottom of a water body **(George *et al*; 2010).**

Among them epibenthic organisms are those that associated with the surface of the sediments by the contrast infaunal organisms live in below the sediment water interfaces and semiinfaunal organisms live partially below the sediment water interfaces but protrude above.

Benthic organisms or soil organisms which are at least 1 mm in length are known as macrofaunal organisms and those organisms that can pass through 1 mm mesh size and be retained on a 42 micrometer mesh size are known as Meiofaunal organisms.**(http://en.wikipedia.org/wiki/Fauna#Meiofauna)**

Algal communities live on the sediment surface but that do not burrow into it are known as Epifloral community. Epiflora are found in the intertidal and subtidal zone, where maximize light available. Epiflora components showed various seasonal patterns of biomass and abundance.
(http://www.Interscience.wiley.com/journal/118502442/abstract2CRETRY=1SRETRY=0)

Epiflora include Blue green algae (Cyanophyceae), Diatoms (Bacillariophyceae), Green algae (Chlorophycae), Cryptomonads, Dinoflagellates, Xanthophyceae and fungi. **(Jamil, 2001)**

Heavy metal contamination levels are generally higher in estuaries than in open sea. Estuaries have high pollution levels of metals, yet continue to support a very high benthic biomass and remain quite productive. **(Dauvin; 2008)** These high concentrations of metals are known to affect benthic macrofauna, macroscopic organisms that live within the sediment matrix or at the sediment water interface **(Clark; 2001).**

Aim of the study: -

Benthic organisms are strongly affected by variation in water and soil quality. As they serve as good indicator species as these organisms being stationary to benthic substrata which reflect the adverse effects of the environmental conditions more clearly than plankton communities. As Estuary gets polluted, along with causing change in physico-chemical characteristic of water, it also affects the marginal and the benthic soils at the edge, thus directly or indirectly influencing the interstitial floral and faunal

assemblages. Therefore, the aim of the study is to check the effect of various physico chemical parameters with respect to benthic communities.

Hence, the benthic community is chosen for the study as:-

Benthic Meiofauna facilitates energy and nutrient transfer to higher trophic evaluations in benthic food web through utilization of micro algae, microbes and detritus.

- Meiofaunal organisms exhibit high sensitivity to organic pollution and facilitate biomineralization of organic matter.
- Meiofauna have shorter generation so they result in relatively rapid cycling of nutrients.
- Epifloral communities present along with faunal organisms in benthic substrata serve as primary producers and are important source of food along with detritus material.
- **IN ORDER TO FULFILL THE AIM OF THE STUDY, THE OBJECTIVES SELECTED ARE-**
- Evaluation of selected Physico-chemical parameters of sub-surface water
- Evaluation of selected Physico-chemical parameters of sediment
- Identification of benthic Epifloral and Faunal community

Methodology :-

To fulfill the objectives and aims of the study, monthly collection will be taken from different station at selected sites .i.e.

Jalalpore - site 1 (Estuarine zone and inlet of domestic sewage.)

Kasbapore - site 2 (Fresh water zone anthropogenic pollution and inlet of smashan bhumi drainage)

Veraval - site 3 (Inlet of domestic sewage and anthropogenic pollution)

The sediment was taken from the sites for the analysis of physico-chemical properties. The samples was taken at monthly intervals. Exposed Mudflats should be selected for the analysis of benthic communities at the selected sites. The soil sample was collected as described by **Nybakken (1988).**

Table 1: -Water Quality Parameters

Sr. no.	Parameter	Method	Source
1	Temperature	By Thermometer	Gupta- 2002(pp.36)
2	pH	Electrometric Method	IS-3025(P-11)
3	Chloride	Argentometric method	APHA-1998(pp.4-67)
4	Dissolved oxygen	Wrinkler's iodometric method	Gupta- 2002(pp.42)
5	COD	Open reflux method	APHA 21st edition 5220 –B (pp-5-15)
6	BOD	3-DAY BOD test	IS-3025(p-44) 1993 re- 03
7	Ammonia	Nesselerization method	IS-3025(P-34)-1988
8	Nitrite	Spectrophotometer method	IS-3025 (P-34)-1988
9	Nitrate	Chromotropic acid method	IS-3025 (P-34)-1988
10	Phosphate	Vanadomolybdophosphoric acid colorimetric method	APHA-1998(pp.4-144)
11	Sulphate	Turbidometric method	APHA-1998(pp.4-178)
12	Salinity	Electrical conductivity method	APHA 21st edition 2520–B (pp-2-48)

Table 2: -Soil Qualit y Parame ters

Sr. no.	Parameter	Method	Source
1	Temperature	By soil Thermometer	Carter-1993(pp.673)
2	pH	Electrometric Method	IS-3025(P-11)
3	Moisture	Gravimetric Method	Gupta-2002(pp.171)
4	Density and p orosity	Laboratory Metho d	Gupta-2002(pp.195)
5	Texture	International Pipette metho d	Gupta-2002(pp.161)
6	Water holding capacity	Laboratory Metho d	Maiti. S.K-2002(pp-155-156)
7	Organic matter	Walkley and Black metho d	Gupta-2002(pp.161)
8	Chloride	Argentometric method	APHA-1998(pp.4-67)
9	Ammonia	Nesseler ization metho d	IS-3025 (P-34)-1988
10	Nitrite	Spectroph otometer metho d	IS-3025 (P-34)-1988
11	Nitrate	Chromotro pic acid metho d	IS-3025 (P-34)-1988
12	Phosphate	Vanado molyb dophosph oric acid color imetric metho d	APHA-1998(pp.4-144)

13	Sulphate	Turbidometric method	APHA-1998(pp.4-178)
14	Copper	AAS	USEPA 3050-B
15	Nickle	AAS	USEPA 3050-B
16	Zinc	AAS	USEPA 3050-B
17	Cadmium	AAS	USEPA 3050-B
18	Lead	AAS	USEPA 3050-B
19	**Uptake study of metal**	**AAS**	**USEPA 3050-B**
20	**Salinity**	**Electrical conductivity method**	**APHA 21st edition 2520–B (pp-2-48)**

RESULTS:

The pH of all the stations indicated the alkaline nature of the stations, which influenced by influx of neritic waters during tidal cycle.

During present investigation seasonal temperature fluctuation was observed at all sites.

The salinity fluctuation was observed among the sites both in water and sediment. The higher salinity was observed at Jalalpore site which is the estuarine zone whereas the concentration was found decreased towards the river ine zone.

The fluctuation in nutrients concentration were found both in water and sediment, which may be due to the fresh water runoff as well as discharge of sewage and the intrusion of sea water during tide.

The Textural data indicate that sediments vary in size from clay, silt and sand.

Among the benthic community, the epiflora community dominated by the Bacillariophyceae group followed by Cyanophyceae, Chlorophyceae and Euglenophyceae.

Navicula sp., Plerosigma sp., Synedra sp., Pinnularia sp., Gomphonema sp., Cymbella sp., Fragillaria sp., Nitzchia sp., Surirella sp., Eunotia sp., Amphora sp. and *Gyrosigma sp.* were present among Bacillariophyceae group.

Among the Cyanophyceae group *Mastagloea sp., Oscillatoria sp., Spirulina sp.* and *Anabaena sp.* were observed.

Among Chlorophyceae group *Spirogyra sp., Scenedesmus sp. and Ankistrodesmus sp.* were recorded.

The benthic faunal communities in intertidal region of Purna were subjected to severe physical and Chemical stresses were represented by Rotifers, Foraminifera, Ciliates, Cladocera, Copepods and Nematodes.

The Polychaete worms were recorded more dominantly at Veraval site. Mud crab was found at all sites in all months.

Boleopthalmus dussumieri (mud skipper) as macrofauna was recorded throughout the study period at all sites.

CONCLUSION: -

Sediment grain size is an important factor which influences the property of sediment. Variation in sand, silt and clay content of sediment also affect pH, Bulk density, Porosity and organic matter content and alternatively affect the benthic community. Among nutrients phosphorous was reported maximum at all the sites during the investigation. Accumulation of heavy metals in crabs and fish found during study.

Diatom population was dominant among the epifloral communities at all the sites. Dominant or high number of diatoms would be indicating the high concentration of nutrients allow the growth of diatoms. **(Habib; 2002)**

Deposition of metals in sediment as well as in different organisms is reported during observation period.

Mud crabs are quite hardy organisms dominant from July to November. The presence of *Boleopthalmus dussumieri* is due to the presence of muddy substratum and the detritus organic food.

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Guide **Research Stude nt**

(Dr. Kapil a Man oj) **(D ange Such ita P ratap)**